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LABORATORY STUDIES ON INTERSPECIES TRAIL FOLLOWING AND TRAIL PREFERENCE OF ARMY ANTS (Dorylinae)

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LABORATORY STUDIES ON INTERSPECIES TRAIL FOLLOWING AND TRAIL PREFERENCE OF ARMY ANTS (Dorylinae)[1]

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ABSTRACT

Laboratory studies of interspecies trail following and trail preference were conducted using workers of *Neivamyrmex nigrescens*, *N. opacithorax*, *N. pilosus*, *N. pauxillus*, *N. wheeleri*, *Labidus coecus*, and queens of the first three species. Ants of all species tested, except *N. pilosus*, readily followed each other's trails. Workers of all species preferred trails laid by their own species, except *N. opacithorax*, which did not show a significant preference for their own trails when compared with those of *N. nigrescens*.

INTRODUCTION

Army ant workers are presumed to be blind and to rely on the laying and following of chemical trails in raiding for food and emigrating from bivouac to bivouac (Wheeler, 1910). They tend to follow trails of scent material deposited by workers from their own colony, or material which is similar in character (Schneirla, 1944). The source of this trail-making material is still a matter of speculation. Watkins (1964a) states that the substance is probably fecal material or some glandular material added to the fecal material. The chemical nature of the trail-marking substance is not known. Testing of army ants on trails laid under laboratory conditions has been done by Watkins (1964a) and Akre (1965). Watkins (1964a) determined that workers of *N. nigrescens*, *N. opacithorax*, and *N. carolinensis* would follow laboratory trails made by workers of each of the other species, but would not follow the trail of *Iridomyrmex analis*, a nondoryline.

The following experiments were designed to test interspecies trail following and the trail preferences of army ants which followed trails of other species. Species tested were *Neivamyrmex nigrescens* (Cresson), *N. opacithorax* (Emery), *N. pilosus* (F. Smith), *N. wheeleri* (Emery), *N. pauxillus* (W. M. Wheeler) and *Labidus coecus* (Latreille).

METHODS

Army ants were collected within a 30-mile radius of Waco, Texas including ants from numerous colonies on the campus of Baylor University. Columns were observed for several hours prior to collecting any part of the colony to determine the status of the colony (nomadic or statary) and to insure the maximum chance of collecting the queen.

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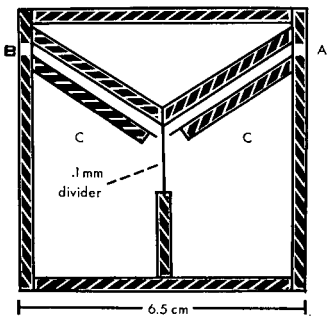

Fig. 1

Fig. 2

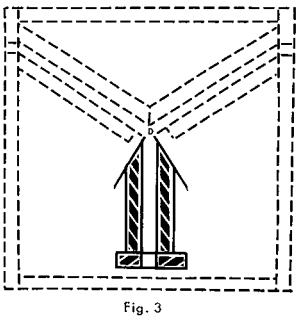

Fig. 3

FIG. 1, Y-trail preference arena. Shaded parts represent balsa wood strips. Unshaded areas represent filter paper. A and B indicate openings through which workers were released to establish trails. C indicates the area where the workers forming the trails were removed from the arena. Fig. 2, Release runway used with the Y-trail preference arena. Fig. 3, Position of release runway on filter paper trail surface. Broken lines indicate the previous position of the balsa strips which were removed before releasing ants from the release runway. D indicates the point where the ants first contacted the chemical trails as they left the release runway.

Workers were collected from both raid and emigration columns. Extensive observing and collecting was done at night when these subterranean species are most active on the surface of the ground. Workers of *N. nigrescens*, *N. opacithorax*, *N. pauxillus*, and *L. coecus* were also collected during the daytime from under rocks and logs.

The workers and queens were placed in laboratory nest boxes similar to those used by Watkins (1964b), and numbered consecutively using a "W" prefix. When numerous workers were collected from the same colony, they were placed in two nest boxes connected by lengths of plastic tubing. The army ants were fed live, immature cockroaches (*Periplaneta americana*), crickets (*Achaeta domestica*), and ant brood. The ant brood was the most readily taken food.

Two types of trail arenas were used in this study, the Y-pattern arena illustrated in Fig. 1 and the V-pattern arena used by Watkins (1964a:24). Both were constructed of 6 mm × 6 mm balsa strips glued together. The floors of the arenas were squares of plate glass covered with squares of No. 3MM filter paper 16.5 cm on a side. The tops of the arenas were squares of clear plate glass.

V-trails, used to test interspecies trail following, were laid in the arenas by allowing approximately 50 workers or one queen to pass across the filter paper surface between the V-shaped trail panels. Trail panels were balsa strips along both sides of the trail lane. The trail lane was marked with a pencil along the outside of the trail panels. Preliminary tests indicated that ants could not follow pencil marks. Any workers remaining in the trail arena were removed and the balsa frame

TABLE 1. Interspecies trail test results (V-trail)

Species and castes tested on trails	Species and castes that made trails*								
	nig. ☿	nig. ♀	opa. ☿	opa. ♀	pil. ☿	pil. ♀	pau. ☿	whe. ☿	coe. ☿
nig. ☿	+	+	+	+	+	+	+	+	+
nig. ♀	+	+	+	+	+	+	+	+	+
opa. ☿	+	+	+	+	+	+	+	+	+
opa. ♀	+	+	+	+	+	+	0	0	+
pil. ☿	-	-	-	-	+	+	-	-	-
pil. ♀	-	-	-	-	+	+	0	0	-
pau. ☿	+	0	+	0	+	0	+	+	+
whe. ☿	+	0	+	0	+	0	+	+	+
coe. ☿	+	+	+	+	+	+	+	+	+

* + = followed trail completely across arena; - = did not follow trail across arena; 0 = species or caste not tested; nig. = *N. nigrescens*; opa. = *N. opacithorax*; pil. = *N. pilosus*; pau. = *N. pauxillus*; whe. = *N. wheeleri*; and coe. = *Labidus coecus*; ☿ = worker; ♀ = queen

with the trail panels was replaced with a frame without trail panels. To test for trail following, a group of 10 workers or one nonphysogastric queen was released from a straight-tube aspirator at one end of the marked trail. A positive trail following test was recorded when one or more ants followed the previously established trail completely across the arena.

The Y-trail arena was used to give the ants a choice between following trails of their own colony or species and those of other colonies or species. Akre (1965) used a similar trail arena to test responses of myrmecophiles to army ant trails. Trails were formed by releasing simultaneously 50 workers from a straight-tube aspirator into the arena at point A and another group from a different colony or species into the arena at point B (Fig. 1). The workers were allowed to pass through the trail lanes to area C. The trails of the two groups were separated by a 0.1 mm divider as the workers passed to area C. The glass arena top and the workers were removed from the trail arena and pencil marks were made along the outer margins of the trail lanes. The balsa frame was then removed from the 16.5 cm square of filter paper on which the trail had been established. The release runway (Fig. 2) was then positioned (Fig. 3) to release the ants to be tested on the trails at point D. Workers were placed in the release runway, one at a time, and allowed to leave the runway so as to contact both previously established trails at the same point D. When a worker followed a trail 2 cm from point D, the worker was removed and the choice recorded. Single workers of the two colonies or species used previously in laying the trails were released alternately until a total of 20 was reached. The paper floor of the release runway was changed after each worker was released. The above tests were repeated one or more times with ants from the same colonies using a new filter paper trail surface and releasing a total of 20 untested workers. In establishing the second

TABLE 2. Results of Y-trail preference tests*

Workers released (species and colony number)	Trail tested and number of workers following trails			
	Trail A	Trail B	χ^2	P
	nig. W-12	*nig. W-14*		
nig. W-12	8	11	.474	> .250
nig. W-14	12	7	1.314	> .250
	nig. W-12	*pil. W-26*		
nig. W-12	18	1	15.22	< .005
pil. W-26	3	16	8.88	< .005
	nig. W-14	*pil. W-26*		
nig. W-14	15	4	6.36	< .025
pil. W-26	2	15	9.94	< .005
	nig. W-29	*pil. W-26*		
pil. W-26	0	16	16.00	< .005
nig. W-29	17	0	16.98	< .005
	pil. W-26	*opa. W-28*		
pil. W-26	14	5	4.26	< .050
opa. W-28	4	15	6.36	< .025
	pil. W-26	*opa. W-28*		
opa. W-28	2	15	9.92	< .005
pil. W-26	14	2	9.00	< .005
	nig. W-12	*opa. W-28*		
nig. W-12	15	5	5.00	< .050
opa. W-28	8	11	.474	> .250
	nig. W-14	*opa. W-28*		
nig. W-14	13	5	3.56	> .050
opa. W-28	10	12	.182	> .500
	nig. W-29	*opa. W-28*		
opa. W-28	7	11	.888	> .250
nig. W-29	15	4	6.36	< .025

* The species and colony numbers are shown in italics. Abbreviations for species names are in the footnote for table 1. Trails A and B refer to trails established on opposite "arms" of the Y-trail. The numbers under each italicized species indicate the workers in the "workers released" column which followed Trail A or B. The numbers are sums of workers following two separate but duplicate Y-trail surfaces.

Y-trail, workers of each species were allowed to form trails on the "arm" of the Y-trail opposite the "arm" on which they had been released in the first test. All releases were made in a dark room lighted with one 150-watt overhead incandescent bulb which had been painted with red tempera paint.

RESULTS

The results of the interspecies trail following test (Table 1) are based upon at least two trials per species. Each trial consisted of the release of a group of 10 workers or one queen on a freshly laid trail. All the workers and queens tested followed trails of their own species. The workers and queens of *N. nigrescens*, *N. opacithorax*, and workers of *L. coecus* readily followed trails of all workers and queens tested.

TABLE 3. Results of trail preference tests*

Workers released (species and colony number)	Trail tested and number of workers following trails			
	Trail A	Trail B	x^2	P
	coe. W-30	*nig. W-29*		
coe. W-30	15	3	8.00	$< .005$
nig. W-29	4	14	5.54	$< .025$
	coe. W-30	*opa. W-28*		
coe. W-30	15	4	6.36	$< .025$
opa. W-28	6	14	3.20	$> .050$
	coe. W-30	*opa. W-28*		
opa. W-28	4	15	6.36	$< .025$
coe. W-30	17	3	9.80	$< .005$
	coe. W-30	*pil. W-28*		
coe. W-30	17	1	14.22	$< .005$
pil. W-26	0	19	19.00	$< .005$
	coe. W-30	*pil. W-26*		
pil. W-26	0	13	13.00	$< .005$
coe. W-30	15	0	15.00	$< .005$

* For explanation see table 2.

The workers and queen of *N. pilosus* followed no trails completely across the arena other than their own. *Neivamyrmex pauxillus* and *N. wheeleri* workers followed trails of all the species tested, but were not tested on trails laid by queens. The observation that *N. pilosus* workers and queen followed trails of the other species poorly or not at all indicates a possible difference in their trail substance from that of the other species and perhaps a more distant relationship.

Results of the trail-preference tests (Tables 2, 3) indicate that, in spite of the ability of many army ant workers to follow trails laid by workers of closely related species, workers of *N. nigrescens*, *N. opacithorax*, *N. pilosus*, and *L. coecus* prefer trails made by workers of their own species, with the possible exception of *N. opacithorax* workers when given a choice between their own trails and those laid by workers of *N. nigrescens*. Workers of *N. nigrescens* did not show a significant preference for trails laid by workers of their own colony when compared with trails laid by workers from another colony of the same species. Although many army ants will follow the trails of other species and the trail chemicals are probably similar, the results of the present study indicate that these trails are different and these differences are detected by the ants.

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